

ON THE THRESHOLD OF THE JOINT FLIGHT

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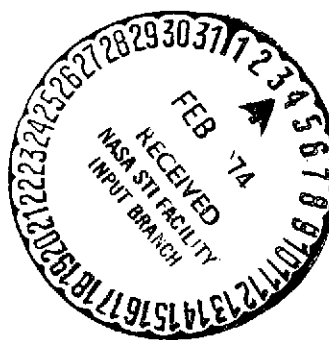
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16. Abstract Three interviews with Soviet personalities involved in the joint Soviet-American space flight to be held in July 1975 are presented. Dr. N. N. Gurovskiy discusses cooperation between the scientists of the USSR and the USA in the field of space biology and medicine. Dr. O. G. Gazendo outlines the forthcoming three-volume 44-chapter work "Fundamentals of Space Biology and Medicine" which represents a joint effort by the scientists of the two nations. Finally, Dr. B. B. Yegorov discusses the various aspects of the joint flight itself, taking up technical problems involving aspects of the joint flight itself, taking up technical problems involving bilingual inscriptions, compatibility of medicines, problems of personal hygiene and the necessity for training in the use of both systems.			
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ON THE THRESHOLD OF THE JOINT FLIGHT

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The Academy of Sciences of the USSR and the National Aeronautics and Space Administration have concluded an agreement on cooperation in the field of space exploration. The special correspondent of the magazine, N. Zykov, approached the head of the Department of Space Medicine of the Ministry of Health of the USSR, Dr. of Medical-Biological Problems of the Ministry of Health of the USSR, Dr. Of Medical Sciences O. G. Gazenko, and hero of the Soviet Union, pilot-cosmonaut of the USSR B. B. Yegorov, with a request that they describe the cooperation of Soviet and American scientists in the field of space medicine. /68*

At the Stage of Exchanging Ideas and Information

Nikolay Nikolayevich Gurovskiy, the co-chairman of the Joint Soviet-American Work Group dealing with the problems of cooperation between the scientists of the USSR and the USA in the field of space biology and medicine speaks:

The principal goal of the cooperation of the physicians of the two nations is to ensure the safety of manned space flights. We shall exchange flight data and examine the most important information concerning the influence of flight factors on the human organism; the most important thing now is to understand those changes which occur in the human organism during space flights and depend primarily upon weightlessness.

Astronauts -- both Soviet and American -- are constantly under the supervision of physicians: they are examined before, after, and during a flight. However, the methods used in these examinations in the USSR and the USA differ in several respects. Therefore, one of the problems which has been solved is to achieve a certain degree of standardization of the examinations.

*Numbers in the margin indicate pagination in the foreign text.

Uniformity of the examination methods is necessary so that we can obtain comparable data by exchanging information. For example, in order to compare the results of the reactions of a cosmonaut or astronaut to a test involving measured amounts of physical stress, the time, magnitude, and nature of the stress must be the same in the examination of Soviet cosmonauts and American astronauts.

A certain measure of success in "reducing the methods to a common denominator" have already been achieved, and the exchange of information concerning the condition of cosmonauts will be more effective from now on.

The Joint Soviet-American Work Group has held three meetings: one in the USA, in the city of Houston, and two in Moscow. At the last Moscow meeting, which was held last year, the results of the flight of the cosmonauts and astronauts aboard the Soyuz and Apollo and the Salyut orbiting station were discussed.

It must be pointed out that in both the USSR and the USA, attempts are being made to simulate the human condition which arises in various stages of space flight, under terrestrial conditions. In particular, we are interested in the changes which develop under weightless conditions. Of course, it is still impossible to simulate complete weightlessness on Earth, but it is possible to develop a rough model.

At the meetings, the American scientists were very interested in reports of our specialists concerning the attempt, under experimental conditions on Earth, to develop and study the reactions of the human organism to conditions when, as is the case in weightlessness, redistribution of the blood occurs with a flow to the upper part of the body -- to the chest and head.

The experiment consisted in having a group of subjects spend 30 days in so-called antiorthostatic positions -- in other words, the head of a subject lying in bed was 4-5° lower than his feet. The reactions of the individual were studied and various means of prevention of undesirable changes in the organism were applied. After completion of the experiment, special methods of rehabilitation were employed; in other words, restoration of all functions, in the same fashion as would be done following the return of a cosmonaut from a flight.

It should be pointed out that each space flight is essentially without precedent, since it always involves the study of some new phenomenon or other. We learn from every flight. /69

The American specialists are studying the experience from our flights and the Soviet specialists are studying the results of the flights of the American astronauts.

The Soviet specialists were interested in the reports delivered by their American colleagues on the effectiveness of adding potassium salt to the diet of the Apollo crews, and how this had a positive effect on the condition of the organism.

Reporting at the joint Soviet-American meeting on the results of observations of the work of cosmonauts aboard the Salyut orbiting station, our scientists described the measures used to maintain the normal condition of the cosmonauts. It was pointed out that the changes in the organisms of the cosmonauts aboard the Salyut station were considerably less than those noted in the crew of the Soyuz-9, whose flight preceded the launching of the Salyut and lasted 18 days.

The results of the medical examination of the first crew of the American Skylab space station show that very effective measures and methods of combatting unpleasant consequences of weightlessness and the reactions of the organism following the end of the flight have been found.

Our nation is not cooperating in the field of space biology and medicine with American scientists alone; we have excellent contacts with scientists in the socialist countries and with scientists in France; but since only the cosmonauts of the Soviet Union and the American astronauts have thus far made space flights, and since there will be a joint space flight of the Soviet Soyuz spacecraft and the American Apollo craft in the near future, I have discussed the cooperation between the scientists of these two countries exclusively.

Unprecedented Work

Oleg Georgiyevich Gazendo tells about the basis for the honorable and responsible task of the co-chairman of the editorial board of the joint Soviet-American publication, "Foundations of Space Biology and Medicine."

Today, two countries, the USSR and the USA, are providing an example of how important and valuable it is to combine the intellectual capacities of various countries. The first step in our collaboration is the publication of a joint scientific work, essentially unprecedented in the history of science, entitled "Foundations of Space Biology and Medicine."

Its preparation has involved the participation of the most outstanding scientists in the USSR and USA. Among the authors are professors at Soviet and American universities, and outstanding specialists in various fields of space biology and medicine who have for many years played a direct role in the preparation and conduct of space flights by man.

The problem faced by the authors of this work was to analyze and summarize /70 all the basic data accumulated in the course of the last fifteen years in the field of space biology and medicine.

The need for such a basic work was created by a number of facts. First of all, there is the abundance of publications in the most diverse sources: the volume of information is so great and at the same time so scattered that it is practically impossible for the specialists to be acquainted with all of the papers that have been published. In addition, an acute need periodically arises in science to consider the experience accumulated on a critical basis and to look forward with an eye toward future development.

For almost two years the joint editorial board has been working out a plan for the contents of the book. As a result, it was decided that the work would be composed of 44 chapters: the Soviet scientists would write 20 chapters and the United States scientists would write an equal number, while four chapters would be prepared jointly by authors from the two nations.

This fundamental scientific work will not be a simple compendium of good articles by outstanding scientists. It will constitute a cohesive whole: all of the chapters will be linked by an internal logical relationship that will be determined by the sequence of presentation of the material and will ensure that the form of the data presented will be most convenient for the reader.

The first volume, [^]entitled "Space as a Living Environment", tells the reader about the origin and structure of the Universe and in more detail about the planets of the Solar System and the medium of outer space where space flights will take place. This volume describes not only physical but biological data and an attempt is made to describe the heavenly bodies and outer space as a distinctive medium of habitation for living organisms, including man.

Among the authors, we find scientists who have enjoyed worldwide fame for a long time, such as Academician A. I. Oparin and Prof. A. B. Rubin, of Moscow University.

The first volume is structured so that the articles that present the basic outlines of the origin of the Universe to the reader successively lead him to the problem of the origin, evolution, and spread of life through the universe, a description of the methods of detecting living matter on the planets of the Solar System, and the problem of the interaction between living organisms and the environment.

In one of the chapters, Academician A. A. Imshenetskiy acquaints the reader with the biological effects of extreme factors in the space environment on living organisms, presenting the results of numerous and very interesting experiments conducted both in our country and in the USA involving laboratory simulation of ecological conditions on Mars, and tells about the characteristics of the vital activity of certain terrestrial organisms in this medium. Obviously, in the not too distant future these data may be compared with the results of direct studies when an automatic biological laboratory makes a landing on Mars, for example.

The second volume is tentatively entitled "Physiological and Ecological Foundations of Space Biology." This volume, on the basis of modern data, will contain a detailed discussion of the influence exerted on man and various biological objects (animals, plants, microorganisms) by spaceflight factors. It must be pointed out that in this area of science, a very great many studies have been conducted and the need for a generalization of the data is acute.

The book will deal in great detail with the reactions of living organisms to the action of individual conditions and spaceflight factors. It is natural that principal emphasis will be placed on two problems: weightlessness and the biological effects of cosmic radiation. The chapter on weightlessness was written jointly by the Soviet specialists Dr. I. D. Pestov and an American professor, Z. Geratewohl. The chapter on cosmic radiation was written by Prof. Yu. G. Grigor'yev in collaboration with K. Tobias.

The articles describe not only the biological effects of certain factors but the mechanisms of their action; what is particularly important, they provide some basis for ways of protecting the organism against possible unfavorable consequences.

Hence, the materials in the second volume lay the foundations, so to speak, for scientific basis for the practical execution of manned space flights.

In one of the chapters in this volume, Dr. of Medical Sciences V. V. Antipov is, as far as I know, the first to make an ingenious attempt theoretically establish the foundation of the particular nature and laws of the reactions that arise in the simultaneous action of several spaceflight factors on the organism, a situation which frequently occurs during flight. This situation is very difficult to analyze and discuss, and it is very hard to work out the necessary practical recommendations. The definite progress and advances that have been made in this important area of knowledge are the result of numerous studies of the problem as well as an exchange of ideas and information between Soviet and American scientists.

The third volume is entitled "Space Medicine." It discusses the problem of medical precautions during manned space flights. There are a great many such problems, of which the most important is the method of selecting cosmonauts and training them; so far, not just anyone can become a cosmonaut.

The expansion of the scientific programs on space flights and the improvement of space technology will increase the number of persons who can join spacecraft crews. Consequently, it is necessary to have a critical analysis of the scientific material accumulated in the field of cosmonaut training and selection, and it is necessary to establish new approaches and recommendations regarding this problem. Dr. of Medical Sciences N. N. Gurovskiy and the American specialist, Dr. M. Link, have jointly prepared an article on this problem /71 which creatively generalizes the tremendous volume of information on cosmonaut and astronaut training accumulated in the Soviet Union and in the United States.

A special place in the third volume is occupied by problem of life support for cosmonauts during flight. In his article, Prof. Ye. Ya. Shepelev attempts to look into the future: he describes the possibilities of ensuring the vital activity of man beyond the Earth on the basis of the development of so-called closed ecological systems with biological branches. This is a fundamental as well as a timely problem for modern biology, closely linked to the national economy.

A number of chapters are "devoted" to psychologists who discuss the problems of space psychology, the problems of rest, work, etc.] during flight, and problems of crew-member compatibility. The famous Soviet scientist, Prof. P. V. Simonov, using our data and the detailed survey compiled by the renowned American psychologist Lindsley, had prepared a chapter on the psychological stresses under spaceflight conditions, including those which can be anticipated in the future.

The three-volume set concludes with a discussion of the problems of ensuring the safety of cosmonauts if unanticipated or emergency situation should arise. Two chapters authored by the Director of the NASA's Medical-Biological Department, Dr. C. Berry are devoted to these problems.

"Foundations of Space Biology and Medicine" will be published in Russian and English simultaneously in the Soviet Union and the USA. The two editions will be practically identical in external format and appearance: a special group of printers and artists from the two countries are working on it.

The publication date of this unprecedented scientific work is not far off: all of the basic work has been completed.

Let's Get Ready for July 15, 1975

Pilot-cosmonaut of the USSR Boris Borisovich Yegorov speaks.

July 15, 1975, will be a memorable date. On that day, we have scheduled the beginning of the joint flight of the Soyuz and Apollo spacecraft. Methods of rendezvous and docking of Soviet and American spacecraft and stations will be tested during the flight. This is necessary to increase the safety factor for manned flights in space and to permit joint scientific studies. The experimental flight will include a transfer of astronauts and cosmonauts from one craft to the other.

Now, following the historic visit of the General Secretary of the Central Committee of the Communist Party of the Soviet Union, L. I. Brezhnev, to the USA, fundamentally new relationships have been established between the Soviet Union and the United States, based on cooperation and mutual understanding. These relationships are particularly favorable to the development of links and contacts for the solution of problems involved in the study and conquest of space.

The experiment, set for July 1975, will solve theoretical problems involving joint activity of different craft and crews in orbit, and will deal with the main problem of how to render assistance to orbiting spacecraft crews.

The Soyuz and Apollo spacecraft differ in both design and environment. The gas mixture in the Apollo cabin consists of nearly pure oxygen or oxygen mixed with a small amount of nitrogen. Aboard the Soyuz, however, the air composition is practically the same as that usually breathed on Earth. The barometric pressure in the Apollo cabin is lower than that on Earth, while in the Soyuz cabin it is about the same as on Earth. The differences in the

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barometric pressure and composition of the gas environment may cause a cosmonaut transferring from one craft to the other to develop painful conditions of the type known as caisson disease: gaseous nitrogen begins to separate from the blood.

In order to allow the transfer of the crews from one craft to the other, a joint solution has been adopted: our specialists have made it possible to reduce slightly the pressure in the Soyuz cabin and the Americans have agreed to raise the gas pressure in their craft.

The atmospheric pressure in the Soyuz cabin will now be 520 mm Hg instead of 760. There will also be an airlock between the two craft. When an astronaut enters this lock from the Apollo, the pressure will be raised to the level in the Soyuz cabin.

The airlock will enable an astronaut or cosmonaut moving from high pressure to low pressure to avoid decompression disease, "washing out" the excess nitrogen and adjusting to the new environment composed of pure oxygen.

The above design characteristics, to be sure, constitute the greatest problem we have faced so far: special problems involving the medical safety of the flight cannot be foreseen -- the flight will be relatively short, experimental and I repeat, for purposes of investigating the possibility of rendezvous, docking and exchange of crews.

On the other hand, there are some simple problems involved in joint operations aboard such craft by crews of different nationalities. Solving them is primarily a task for the psychologists dealing in the problems of crew compatibility and those problems which have to do with the problem of exchanging information. The labels in the spacecraft cabin obviously will have to be in two languages -- Russian and English. Of course, there are many details requiring serious attention. Let us say, for example, that an Apollo astronaut comes aboard our spacecraft and has to take a headache pill from the medicine chest, but has already taken some other medication. What should he do? Should he take the pill or not? Our problem, the problem of the physician, is to solve the problem of the compatibility of the

medicinal preparations in the medicine chests aboard the two spacecraft.

The next problem is to determine methods of medical preparation of cosmonauts for flight and methods of postflight examination, in other words, standardization of the medical examination of cosmonauts which Dr. of Medical Sciences Nikolay Nikolayevich Gurovskiy discussed. The method will have to be the same for us and for the Americans, and the corresponding parameters will have to be recorded on the same kind of instruments so that the data can be easily compared and evaluated. /73

During the flight, as we know, all of the indications concerning the condition of the cosmonauts will be received jointly by Soviet and American specialists.

By agreement with the US specialists, the crews of the Soyuz and Apollo spacecraft will undergo joint training in the Soviet Union at the Yuriy Alekseyevich Gagarin Cosmonaut Training Center and at the Manned Spacecraft Center in Houston in the United States. The first visit of the Soviet cosmonauts for this training in Houston took place in July of last year. Cosmonauts A. Leonov, V. Kubasov and their backups made the trip.

We have prepared a program of lectures for the American astronauts. In particular, in conjunction with the medical aspects of the flight, these lectures tell how to use the food products aboard the Soyuz, what these products are made of, and what their composition and caloric content are. We plan to give them instructions on using the medicine chest, instruments for medical monitoring, and equipment for personal hygiene.

Personal hygiene aboard a spacecraft in flight is not a simple problem. Among the devices for personal hygiene, special napkins have been developed: some are dry, while others have been moistened with special fluids such as cleansing lotions. By using such napkins, the cosmonauts can take care of their personal hygiene. Even shaving is somewhat of a problem in space. Most persons prefer to shave with safety razors, so special moistening fluids and creams have been developed. Mechanical or electric shaving of the usual kind is simply impossible, even dangerous in flight -- the clipped hairs and hair

dust fly immediately into the air and may be inhaled into the lungs. Mechanical shavers developed for the cosmonauts constitute a "symbiosis" of a razor and a vacuum cleaner.

Both Soviet cosmonauts and American astronauts will have to become mutually acquainted with the details of the water supplies aboard the craft. Aboard the Soyuz there are supplies of drinking water brought from Earth, while the water aboard the Apollo is obtained from fuel cells and is a sort of byproduct of the operation of the thermochemical devices. This water is purified and can be used by the crew. Naturally, our cosmonauts will have to become intimately familiar with the American water-supply system and the American crew will have to become equally familiar with ours.

Aboard the Apollo spacecraft considerable emphasis is placed upon fire safety, since the atmosphere in the cabin is composed of pure oxygen. Naturally, our cosmonauts will have to be extremely careful to observe all rules concerning this type of safety when they cross over to the Apollo; in particular, they will have to wear special clothing.

The most interesting and important stage of the flight as far as we physicians are concerned will occur when the crews cross over from one craft to the other: it is important to learn how the cosmonauts will react to the changes in their accustomed environments.

We suggest that there will be no unpleasant surprises, because all the necessary measures to ensure a reliable working capacity for the cosmonauts will have been taken.

Now, in anticipation of the memorable date of July 15, 1975, we will have to continue our work and training.

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